

MESSENGER Searches for Less Abundant or Weakly Emitting Species in Mercury's Exosphere

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Mercury's exosphere is composed of material that originates at the planet's surface, whether that material is native or delivered by the solar wind and micrometeoroids. Many exospheric species have been detected by remote sensing, including H and He by Mariner 10, Na, K, and Ca by ground-based observations, and H, Na, Ca, Mg, and Ca⁺ by the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) spacecraft. Other exospheric species, including Fe, Al, Si, O, S, Mn, Cl, Ti, OH, and their ions, are expected to be present on the basis of MESSENGER surface measurements and models of Mercury's surface chemistry. Here we report on searches for these species made with the Ultraviolet and Visible Spectrometer (UVVS) channel of the Mercury Atmospheric and Surface Composition Spectrometer (MASCS). No obvious signatures of the listed species have yet been observed in Mercury's exosphere by the UVVS as of this writing. It is possible that detections are elusive because the optimum regions of the exosphere have not been sampled. The Sun-avoidance constraints on MESSENGER place tight limits on instrument boresight directions, and some regions are probed infrequently. If there are strong spatial gradients in the distribution of weakly emitting species, a high-resolution sampling of specific regions may be required to detect them. Summing spectra over time will also aid in the ability to detect weaker emission. Observations to date nonetheless permit strong upper limits to be placed on the abundances of many undetected species, in some cases as functions of time and space. As those limits are lowered with time, the absence of detections can provide insight into surface composition and the potential source mechanisms of exospheric material.